DISCOVERY

CRITERIA AND GUIDELINES FOR THE PHASE A CONCEPT STUDY

February 9, 2007

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CRITERIA AND GUIDELINES FOR THE PHASE A CONCEPT STUDY

INTRODUCTION

The Missions and Missions of Opportunity proposals submitted to the Discovery Program 2006 and Missions of Opportunity Announcement of Opportunity (AO) that were selected for a competitive Phase A study will conduct a concept study to better define the investigation, its implementation requirements (both engineering and management), and its risks, as well as to describe the implementation plans for education and public outreach. The Phase A concept study for each investigation will constitute the investigation's requirements definition phase (Phase A) of the formulation subprocess as outlined in NPR 7120.5C, *NASA Program and Project Management Processes and Requirements.* The Phase A concept study period can also be utilized to mature the proposal concept presented in response to the AO by demonstrating proof of concept and/or conducting additional development testing to reduce/retire risks. In addition, it is expected that the proposer will utilize the Phase A concept study period to refine requirements and project interfaces with the JPL Interplanetary Network Directorate, and other critical support functions. Signed Letters of Endorsement from each of these critical support elements are mandatory to provide assurance that the project's requirements have been assessed and are supportable. Finally, and perhaps most importantly, the Phase A period should be utilized to finalize all cost estimates, and develop the needed project funding profile necessary to implement the investigation with an acceptable level of risk. During the Concept Study, the NASA SMD Cost shall not increase by more than 20 percent from that offered in the original proposal and, in any event, must not exceed the total cost cap. Thereafter, cost shall not increase from that offered in the Concept Study Report. Each Concept Study must conclude with a commitment from the PI for the cost, schedule, and scientific performance of the investigation. If, at any time, the cost, schedule, or scientific performance commitments appear to be in jeopardy, the investigation shall be subject to termination or cancellation.

Upon completion of the Phase A concept study, proposers will submit a Concept Study Report (CSR) for NASA evaluation. The CSR is to be a self-contained document; that is, selected investigators should not assume that NASA evaluators will have reviewed or even have access to the original proposal. Please note that all program constraints, guidelines, definitions, and requirements given in the AO are still valid for the CSR except as noted herein. Likewise, specific guidelines and definitions for proposal preparation are still valid for the CSR except where specifically amended in this document (for example, page counts are amended herein to account for the added degree of expected maturity of the investigation's implementation).

Proposers should be aware that they are responsible for the content and quality of the entire CSR, including parts that may be prepared by any of their partners. All assumptions and calculations should be carefully documented in the CSR and reviewed by the Principal Investigator and his/her team to ensure that they are accurate and will satisfy the requirements of NASA and its supporting organizations.

The CSR for Missions is due by 4:00 PM Eastern time, June 20, 2007, at the address below.

The CSR for Missions of Opportunity is due by 4:00 PM Eastern time, March 20, 2007, at the address below.

Discovery Program 2006
Science Mission Directorate
NASA Research and Education Support Services (NRESS)
500 E Street SW, Suite 200
Washington DC 20024
Tel: 202-479-9030

Site Visits

In addition to the CSR, the evaluation process will also include a site visit by the evaluation team to hear oral briefings by each of the investigation teams. For planning purposes, these oral briefings can be expected to last one full workday and would be conducted approximately 1 month after the CSR has been submitted. Scheduling the site visit will be addressed at the Phase A Kickoff meeting.

It is recognized that Discovery investigations are subject to three kinds of risks: inherent risks (including launch and space environments, mission durations, and unknowns); programmatic risks (those uncertainties imposed by the program such as Environmental Assessment approvals, budget uncertainties/changes, political impacts, and late/non-delivery of government-provided project elements); and implementation risks (those elements under the control of the investigation team including such things as schedules, funding allocations, management structure, development approach, supporting organizations, and risk aversion/management approach including planning for known and unknown inherent and programmatic risks). The primary purpose of the Phase A Concept Study is to develop detailed implementation plans for the proposed investigation so that implementation risks can be evaluated. (At the same time, however, any special features of the proposed investigation that add unusual resiliency against either inherent or programmatic risk should be described.)

Part I of this document discusses the criteria to be used by NASA for the evaluation of the CSR. Part II provides guidance for preparation of the CSR. Preliminary guidelines for the project site visits will be presented at the Phase A Kickoff Meeting at NASA HQ.

As a result of the evaluation of the Concept Studies, the Associate Administrator for the Science Mission Directorate expects to confirm one or more Discovery mission investigation to proceed to Phase B through the exercise of an option under that team's existing contract with NASA. Any MO investigations selected for Phase A study may or may not be selected to continue to Phase B. NASA will not continue funding for investigations that are not selected to proceed. All investigation teams will be offered a debriefing of all findings.

PART I - EVALUATION CRITERIA

The NASA evaluation process of the Phase A concept studies will be conducted in much the same fashion as the evaluation of the proposals as discussed in Section 7.0 of the AO, with the exception that Categorization will no longer be required. Since the selected investigations are those judged to having compelling science, it is expected that the science objectives would not change during the Phase A studies. If, however, there are changes to the science implementation that might affect these objectives, the science merit will be re-evaluated. Assuming that there are no changes to the science objectives from those in the proposal, the Phase A evaluation will primarily be to evaluate all of the implementation planning for each investigation and consider in detail all factors related to the probability of mission success and to the realism of the proposed costs to NASA. This evaluation will also consider the investigation team's pans for Education and Public Outreach (E/PO) and any Student Collaboration (SC), Science Enhancement Opportunity (SEO), or Technology Demonstration Opportunity (TDO).

Successful implementation of Discovery investigations demands, in addition to scientific merit, that the investigation be achievable within the established constraints on cost and schedule. The information requested in Part II of this document will enable the evaluation panel to determine how well each mission team understands the complexity of its proposed investigation, its technical risks, and any weaknesses that require specific action during Phase B.

The three criteria to be used for evaluation of the CSR are as follows:

- The scientific merit of the proposed investigation (will not be re-evaluated unless it is determined that the science has changed from that described in the proposal);
- The scientific implementation merit and feasibility of the proposed investigation;
- The feasibility of the proposed approach for mission implementation, including cost risk and SDB plan;

For full missions, approximately half of the overall evaluation will be determined by the feasibility of the proposed approach for mission implementation, and approximately one quarter of the overall evaluation will be determined by the scientific merit and the remaining overall evaluation will be determined by the science implementation merit and feasibility of the proposed investigation.

For missions of opportunity, approximately half of the overall evaluation will be determined by the scientific merit, a third will be determined by the merit of the scientific implementation and its feasibility, and the remainder by the feasibility of the proposed approach for mission implementation.

Additional selection factors include:

- The NASA SMD cost;
- The quality of plans for education and public outreach (E/PO); and

- The merit of any SC, SEO, TDO (either in the original proposal or added during Phase A).

Scientific Merit of the Proposed Investigation

It is expected that the science objectives will not change from those given in the proposal. However, the scientific merit of each investigation as established by the peer review of the proposal will be reexamined to determine if significant changes have occurred as a result of details provided in the Phase A CSR with regards to the implementation details of the science investigation. If a re-evaluation is judged to be necessary, the definitions and process for evaluating this criterion will be the same as those defined in the original AO and used for the peer review. Given no change in the science, the peer review panel rating of the original proposal will remain valid for the CSR.

Scientific Implementation Merit and Feasibility of the Proposed Investigation

The information provided in response to Part II of this document will be used to evaluate each investigation in detail for its technical merit, scientific feasibility, resiliency, and probability of success. Although this criterion was evaluated during the proposal phase, it will be re-evaluated as a result of the Phase A concept study, which now will have science implementation details for evaluation. As a result, the evaluation of this AO criterion will be supplemented with the following considerations:

> *The scientific implementation of the investigation will be reevaluated from the data provided in the CSR and the site visit to look specifically at the level of implementation risk based on the feasibility of the investigation's technical approach, instrumentation provided to acquire the data, maturity of the Level 1 science requirements, plans for science operations and data acquisition, plans for science descope, technical capabilities of the investigation team, and the plans for data analysis and archiving.*

Feasibility of the Proposed Approach for Mission Implementation, including Cost Risk

The information provided in the CSR (as described in Part II of this document) will be used to evaluate the feasibility of mission implementation, as reflected in the perceived risk to accomplishing the mission within the proposed resources. The mission feasibility as a whole, and as reflected in the primary subfactors of Instrumentation, Mission Design and Operations, Spacecraft/Flight Systems, Management and Schedule, and Cost, will be assessed as well as the feasibility of each of these subfactors separately. The AO criterion will be supplemented with the following considerations:

The evaluation will consider the proposer's understanding of the processes, products, and activities required to accomplish development of all elements (e.g., mission design, launch systems, flight systems, communications systems, ground systems, and data

systems), the integration of all elements, and the adequacy of the proposed approach including reserves and margins. The mission operations approach will be evaluated to determine the adequacy of the plans and the resources for conducting the mission. The technical approach will be examined in its entirety to ensure that: (1) all elements and processes are addressed, (2) weaknesses and design issues are understood and plans for resolution have been identified, (3) fundamental design trades have been identified and studies planned, and (4) primary performance parameters have been identified and minimum thresholds established. The overall technical approach (including a well-defined schedule), the specific design concepts, and the proposed hardware and software will be evaluated for soundness, achievability, and maturity. Resiliency and design performance margins will be factors in this evaluation. The advantages (e.g., higher performance or lower costs) and disadvantages (e.g., higher technical risk) of any new technology will be evaluated in the context of the overall feasibility of the proposed investigation. Investigations dependent on new technology will not be penalized for risk provided that adequate plans are described to provide a reasonable backup approach that will assure the success of the investigation within the proposed resources.

The experience and expertise of the development organizations will be important factors in assessing the implementation risk. Innovative cost effective features, processes, or approaches will be rewarded if proven sound. The information provided on the project management should demonstrate the proposer's plans, processes, tools, and organization for managing and controlling the development and operation of the mission, including performance measurement and reporting. The soundness and completeness of the implementation approach as defined in a Work Breakdown Structure (WBS) and the potential that the investigation team can assure mission success will be evaluated by reviewing the organizational structure (including roles, responsibilities, accountability, and decision making process) and the processes, plans, and strategies the team will use to manage the various mission elements. Factors in this evaluation will include: clear lines of authority, clean interfaces, prudent scheduling and cost control mechanisms, review processes, and demonstrated awareness of all necessary management processes. The adequacy with which risk management activities are planned and budgeted are also factored into this evaluation. Additional factors in the evaluation of the potential of mission success will include the experience and past performance, expertise, and commitment of key personnel and the organizations to which they are attached, the adequacy of facilities and equipment proposed for the mission, the adequacy of the team's approach to risk management, and the adequacy of the management and control mechanism. Innovative management processes and plans will be rewarded if proven to be sound.

The completeness of the Phase B plans will also be considered in determining the adequacy of the overall implementation approach. This will include an evaluation of the activities/products, the organizations responsible for those activities/products, and the detailed schedule to accomplish the activities/products.

The credibility and realism of the proposed cost estimates and the planned financial resiliency will be evaluated. The underlying rationales for the cost estimates, including adequate (see section 1.1 of the AO), technical reserves and margins, and the development schedule, including schedule margins, will be factors in this evaluation.

The subcontracting plan will be evaluated on whether the proposer provides maximum practicable opportunities for small business participation and on the extent of participation of small disadvantaged business concerns. The effect of the subcontracting plan on the technical, management, or cost feasibility of the proposed investigation will also be evaluated. See Section 5.8 and Appendix A, Section XIII of the AO for details concerning small and small disadvantaged business requirements.

Additional selection factors include the Total Cost to NASA and the merit of the E/PO plan. If proposed, the merit of a SC, SEO or TDO may be considered in selection.

Quality of Plans for Education and Public Outreach including Implementation Feasibility

All proposed investigations must include an Education/Public Outreach component, described fully in the CSR. The criteria to be used to evaluate the E/PO component and a discussion of those criteria is given in the document *Explanatory Guide to the NASA Office of Space Science Education and Public Outreach Evaluation Criteria* (March 2004), which may be found in the Discovery Program Library. See section 5.6.1 of the AO for further details on the E/PO requirements.

Merit of Proposed Student Collaboration (SC)

The Concept Study may include a Student Collaboration (SC) that involves development of an instrument, investigation of scientific questions, analysis and display of data, development of supporting hardware or software, and/or other aspects of the mission. The activities may involve flight, suborbital, or ground systems. An evaluation of the feasibility includes assessing whether the scope of the investigation is appropriate and follows the guidelines in section 5.6.2 of the AO. The constraints on the proposed SC are that it must be clearly separable from the proposed baseline investigation and the performance floor science investigation to the extent that it will not impact the proposed investigation or minimum science mission if the SC development has technical, schedule or cost problems and is deleted from the mission, or if the SC fails in flight. The proposer must clearly identify the development schedule of the SC and describe how it can be developed so as to be separable from the proposed baseline science investigation and performance floor science investigation. Review and decision points for determining the SC readiness for flight must be identified. The cost of the SC must be included under the NASA cost cap. The cost of the SC must be identified separately from the proposed investigation. If NASA chooses to proceed to Phase B of the proposed mission, NASA may or may not elect to process with the SC.

Merit of Science Enhancement Opportunity (SEO) or Technology Demonstration Opportunity (TDO)

SEOs or TDOs are optional and may be offered to NASA in addition to the Baseline Mission or Investigation. The evaluation of the merit of the proposed SEO or TDO

includes an assessment of whether it provides an enhanced science return, an advance in NASA's technology base, uses innovative technology approaches to achieve the scientific goals, uses innovative technologies that may have continuing applicability to future SMD mission, or provides benefits to the baseline mission and future missions.

An evaluation of the feasibility includes assessing whether the scope of the investigation is appropriate and follows the guidelines in section 5.11.4 of the AO. The evaluation will also address whether the SEO or TDO is clearly separable from the Baseline mission to the extent that it will not impact the proposed Baseline Mission if the SEO or TDO development or operation has technical, schedule, or cost problems, and is deleted from the mission or fails in flight. A separate cost must be provided for each proposed SEO or TDO but both must be included under the cost cap. The likelihood of completing the proposed development for the proposed cost will be assessed. The development plans, schedule, and funding will be evaluated. The development schedule and risk management approach will be assessed to determine if the development is feasible and appropriate review and decision points are identified during development to assess whether further investment is warranted or is ready to proceed to the next milestone or flight. The cost of a SEO or TDO must be included under the NASA cost cap. The cost of the SEO or TDO must be identified separately from the proposed investigation. If NASA selects the proposed mission or MO, NASA may or may not fund the SEO or TDO.

PART II
REQUIRED QUANTITIES, MEDIA, FORMAT, AND CONTENT

The signed original of the CSR, fifty (50) paper copies, and an additional twenty-five (25) copies of the Fact Sheet are required. It is required that each paper copy of the CSR be accompanied by a CD containing an electronic PDF format version of the CSR in a single file. The PDF document must be searchable and bookmarks must be used to outline major sections of the document. Proposers must also submit the data in cost tables as separate files on the CD. Each of these cost tables including the headings for the rows and columns must be in a tab-delimited text file. Optionally, versions of these files in Excel can also be included. Also, the schedule in MS Project format must be included on the CD. Each CD that will accompany the original or a copy of the CSR must include the required files. *These CDs and the files must be readable with both PC and Mac computers.* The required uniform format and contents are summarized below. Failure to follow this outline may result in reduced ratings during the evaluation process.

If beneficial to the understanding of potential data products or mission operations concepts, the CD may include up to four (4) simple simulations, e.g. QuickTime movies, that are referenced and described in the CSR. Other than these simulations, do not include any other information on the CD that is not included in the paper volumes of the CSR. Additional information on websites may not be referred to in any version of the CSR.

When changes from the original proposal have been made to the science investigation (including science implementation) as a result of the concept study, these changes from the proposal must be clearly identified. See sections E and F for information on highlighting changes. Note that all program constraints, guidelines, requirements, and definitions given in the AO are still valid for the CSR except as noted herein.

The CSR page limits are shown on the next page. Other guidelines are as follows:

- The CSR shall contain no more than seven foldout pages;
- A foldout page (up to 11 x 17 inches) counts as one page;
- All pages other than foldout pages shall be 8.5 x 11 inches or A4 European Standard;
- Pages may be single- or double-column format;
- No page may contain more than 55 lines of text;
- Type fonts must not be smaller than 12-point except within figures and tables, where the type font must not be smaller than 10-point; and
- Three-ring binders may be used.

The following page limits apply:

Section	Mission Investigation Page Limit	MO Page Limit
A. Cover Page and Investigation Summary	As needed	
B. Table of Contents	5	
C. Fact Sheet	2	
D. Executive Summary	5	
E. Science Investigation (changes highlighted)	35	30
F. Technical Approach G. Management Plan H. Phase B Plan	94	70
I. Education and Public Outreach Plan (including SC)	E/PO 4, SC 5	
J. Cost Information for Phase A through E: Cost Proposal for Phase B Cost Estimate for Phase C/D Cost Estimate for Phase E Cost Estimate for SC, SEO, or TDO Cost Estimate for E/PO Estimate for Total Mission Cost	No page limit, but data must be presented in formats described.	
K. Plans for Participating Scientist Program, Data Analysis Program, and/or Guest Observer Program (optional)	1 page per program	
L. Appendices (No other appendices permitted) Letters of Endorsement Subcontracting Plan Relevant Experience and Past Performance Resumes Statement(s) of Work for Each Contract Option Draft Requirements Appendix to Discovery Program Plan Radioactive Heating Units/Power Sources Plan (as applicable) Planetary Protection Approach Any Incentive Plan(s) Compliance with Procurement Regulations by NASA PI (if applicable) Technical Content of Any International Agreements Discussion on Compliance with U.S. Export Laws Communications Link Budget Design Data Cost and Pricing for Phase B Contract Additional Cost Data to assist Validation Science Change Matrix Data Management Plan Sample Curation Orbital Debris Analysis Reference List (Optional) Abbreviations/Acronyms List	No page limit, but conciseness is encouraged	

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A. COVER PAGE AND INVESTIGATION SUMMARY

The content of the cover page and proposal summary is defined in Appendix B section A of the AO. However, the NSPIRES system referred to in the AO will not be used for this step to generate the cover page. Proposers should generate a cover page and provide the content described in Appendix B section A of the AO for the cover page information and the proposal summary.

Note: An official of the proposing organization who is authorized to commit the organization's resources to the proposed investigation must sign the Cover Page.

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B. TABLE OF CONTENTS

The CSR shall contain a table of contents that parallels the outline provided in Sections C through L below.

C. FACT SHEET

A Fact Sheet that provides a brief summary of the proposed investigation must be included. The information conveyed on the Fact Sheet should include the following: science objectives (including the importance of the science to the NASA science theme(s)), mission overview (including mission objectives and major mission characteristics), science payload, key spacecraft characteristics, anticipated launch vehicle, major elements of the E/PO program, mission management (including teaming arrangement as known), schedule, cost estimate, and SC, SEO or TDO. Other relevant information, including figures or drawings, may be included at the proposer's discretion. The Fact Sheet is restricted to two pages (preferably a double-sided single sheet).

D. EXECUTIVE SUMMARY

The Executive Summary is to be a summary of the contents of the CSR and should include an overview of the proposed baseline investigation including its scientific objectives, technical approach, management plan, cost estimate, education and public outreach, and any SC, SEO, or TDO.

E. SCIENCE INVESTIGATION

This section should describe the science investigation resulting from the Phase A Concept Study. Any descoping of, or changes to, the investigation from the baseline and minimum mission science defined in the proposal must be identified in this section. Changes should be highlighted in bold with change bars for easy identification. In addition, a change matrix giving the original (proposed) requirement, the new requirement, rationale for the change, and its location within the

CSR is required as an appendix (see section L). If there are no changes, to the science investigation section must be repeated identically from the proposal with a statement that there are no changes.

F. TECHNICAL APPROACH

The Technical Approach section should detail the method and procedures for investigation definition, design, development, testing, integration, ground operations, and flight operations. Proposers must provide a sufficient level of detail to allow NASA to validate all aspects of the mission concept. Failure to provide sufficient detail could cause NASA to be unable to validate the concept, which could result in a High Risk rating. A discussion of all new technologies planned for the investigation must be provided and include backup plans with scheduled decision criteria if those technologies cannot be made ready. This section should also detail the expected products and end items associated with each phase. Mission teams have the freedom to use their own processes, procedures, and methods. The use of innovative processes, techniques, and activities by mission teams in accomplishing their objectives is encouraged when cost, schedule, technical improvements, and risk containment can be demonstrated. The benefits and risks, if any, of any such processes and products should be discussed. The section should also describe any proposed SEOs or TDOs. This section must be complete in itself without the need to request additional data, although duplications may be avoided by reference to other sections of the CSR if necessary.

For Missions of Opportunity, provide the information that is related to the proposed investigation and its requirements on and interfaces with the host spacecraft. Provide sufficient information to assess whether the existing spacecraft systems and resources are sufficient to carry out the proposed Mission of Opportunity.

1. Technical Approach Overview. This section should provide a brief overview of the technical approach including its key challenges.
Note: this applies to both Full Mission Proposals and Missions of Opportunity.

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2. Mission Design. This section should fully describe the operational phase of the mission from launch to end of mission. It should include information on the proposed launch date (including any launch date flexibility), launch location and vehicle, trajectories, Delta-V requirements, orbit characteristics, encounter geometry (orbiter, flyby, lander, etc.) and characteristics (flyby speed, orbital period, etc.), mission duration, and a preliminary mission timeline indicating periods of data acquisition, data downlink, etc. It should also include detailed analyses of all phases of the trajectory/orbit design including total delta-V, times of trajectory correction maneuvers and delta-V's, and contingency studies and details for major events on the trajectory. The mission design should also describe the interface requirements for the Deep Space Network (DSN) or other communications network to be used, along with potential impacts or conflicts with other users of the selected communications resources. Describe any design trade studies conducted or

planned. Any trade studies involving launch vehicles must still require that NASA be the launch service provider unless it is to be a contribution. In such cases, the AO guidelines and constraints for both contributions and launch vehicles will be applicable.

A "traceability matrix" showing how the proposed mission design complies with the stated objectives, requirements, and constraints of the proposed investigation, including planetary protection compliance, should be included. The rationale for the selection of launch vehicle should be included. The concept study should identify any innovative features of the mission design that minimize total mission costs.

Note for Missions of Opportunity: Provide the information in the mission design section if it is applicable for your Mission of Opportunity. For instance, if the Launch has already occurred then no discussion on the launch date, location, vehicle, etc. is necessary.

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3. Technology. This section should discuss how the subject technology relates to the proposed investigation, from which project(s) the technology comes and its current level of technology readiness, modifications necessary in order to utilize the technology for this investigation, and whether there are workarounds for the technology if plans for its usage on this investigation cannot be affirmed by Preliminary Design Review (PDR)/Confirmation. The functions that the new technology performs and how it will be demonstrated for the investigation should be described.

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Note for Missions of Opportunity: This paragraph may not be applicable to Missions of Opportunity that are not developing hardware. Proposers should consider whether this paragraph applies to proposed new software tools or data processing and analysis tools.

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For SEOs or TDOs, this section should discuss how the SEO/TDO provides an enhanced science return, an advance in NASA's technology base, uses innovative technology approaches to achieve the scientific goals, uses innovative technologies that may have continuing applicability to future SMD mission, or provides benefits to the baseline mission and future missions. The section must also describe how the SEO or TDO it is clearly separable from the Baseline mission to the extent that it will not impact the proposed Baseline Mission if the SEO or TDO development or operation has technical, schedule, or cost problems, and is deleted from the mission or fails in flight. The development plan, development schedule, and risk management approach must be described in sufficient detail to determine the likelihood of completing the proposed SEO/TDO development for the proposed cost. Appropriate review and decision points must be described during development to assess whether further investment is warranted or is ready to proceed to the next milestone or flight. The proposed plan for bringing each of the identified items to a minimum of TRL 6, defined as "system/subsystem model or prototype demonstration in a relevant environment, space, or ground" by Confirmation Review (CR) at the end of Phase B (include

discussion of simulations, prototyping, systems testing, life testing, etc., as appropriate); and backup plans, if any, should be described.

4. Spacecraft – Mission Proposals. This section should describe the spacecraft design/development approach, particularly as it relates to new versus existing hardware and software and redundant versus single-string hardware. It should fully identify the spacecraft systems and describe their characteristics and requirements. A description of the flight system design with a block diagram showing the flight subsystems and their interfaces should be included, along with a description of the flight software and the approach for its development, and a summary of the estimated performance of the flight system. The flight heritage or rationale used to select the flight system and its subsystems, major assemblies, and interfaces should be described. The discussion of heritage should address two important issues: (1) prior flight experience or flight-qualified design of specific subsystem hardware and software components, and (2) overall subsystem design, whether new, modified, or exact repeat of a design flown previously. Assumptions about potential cost savings that result from heritage will be quantified and explained in the Cost Proposal section (Section J) below. This section should also discuss the design *process* used: trade studies, simulations, technology development, engineering models, prototypes, etc.

   Subsystem characteristics, requirements, and expected performance should be described to the greatest extent possible. These subsystems include: structural/mechanical, solar array/power supply (and batteries), electrical, thermal control, propulsion, communications, attitude control, command, and data handling, etc. Characteristics include current best estimate and contingency for: mass, volume, and power requirements; performance; pointing knowledge and accuracy; new developments needed; space qualification plan; and expected degradation/losses. Include block diagrams with sufficient detail to allow NASA to determine the adequacy of the proposed subsystem.

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   Any design features incorporated to effect cost savings should be identified; however, benefits should be specified and enabling assumptions or risks should be identified. A summary of the resource elements of the flight systems design concept, including key margins, should be provided. The rationale for, and derivation of, margin allocations including mass, power, communication link performance (data and carrier), pointing accuracy, etc., should be provided. Those design margins that are driving costs should be identified. Provide data in tables to show the current estimate of data storage margin and computer processor utilization margin. A Master Equipment List should summarize component-level information for all hardware subsystems of the spacecraft and any other hardware elements (e.g., probes, canisters, and individual instruments). The quantity, unit current best estimate mass, estimated contingency mass percentage and value, and the current best estimate mass plus contingency mass value should be provided for each component. Component-level mass estimates should be presented

individually and summed at the subsystem and system level. Heritage, design status, level of modification planned, and new development should also be provided for each component.

Show how the characteristics of and requirements on the spacecraft are traceable to the objectives, requirements, and constraints of the investigation.

Spacecraft Impact – Missions of Opportunity. For Missions of Opportunity (MO), describe the impact of the planned MO on the Host mission spacecraft operations and/or other investigations. Describe the spacecraft systems capabilities and show how they support the science requirements of the MO. Describe and quantify the flight software changes, development schedule, testing and verification. Describe how the expected lifetime of the Host spacecraft and resiliency of spacecraft systems either through resource margins and or system redundancy will ensure the planned MO can be completed.

5. Science Implementation. This section must describe the science implementation for the investigation, including the sample acquisition and processing system. Highlight any changes to the payload or individual instruments or their performance since submission of the proposal and provide a summary in the Science Change Matrix (see section L). Information pertinent to the accommodation of the instrumentation on the spacecraft must also be included. Subsystem characteristics and requirements must be described. Such characteristics and requirements include: mass, volume, and power requirements; computing and data resource requirements, pointing requirements; new developments needed; and a space qualification plan. Include block diagrams, layouts, calibration plans, operational and control considerations, and software development. Any design features incorporated to effect cost savings should be identified. A summary of the resource elements of the instrument design concept, including key margins, must be provided. The rationale for margin allocation must be provided. Those design margins that are driving costs should be identified. The Master Equipment List should summarize component-level information for each instrument, including payload common elements.

   Special attention should be given to assuring that both the planning and resources are adequate to analyze, interpret, and archive all the data produced by the investigation in the appropriate data archive (Planetary Data System or other, as justified). Include a discussion of the software system that will be used, the amount of new development, the team structure and staffing concept and location, and interfaces for the instrument processing system(s). The approach for science algorithm development (if appropriate) and the integration of the algorithms into the processing system should also be discussed. Resources include cost, schedule, and man-hours for scientific interpretation of results and publication.

Show how the characteristics and requirements of the science implementation are traceable to the objectives, requirements, and constraints of the investigation.

The draft Level 1 science requirements of the investigation, as agreed to by the PI, PM, and other key personnel, must be clearly identified in this section.

Note for Missions of Opportunity: address items above as applicable for your mission of opportunity. For instance, if using an existing spacecraft, a discussion of reserves to cover hardware development issues is not necessary. However, the proposer must demonstrate that the existing spacecraft and its systems and resources are sufficient to support the planned mission design, conduct the planned science operations, and provide the planned science data acquisition and processing.

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6. Payload Integration. This section should characterize the interface between the instruments and the flight system. These include, but are not limited to: volumetric envelope, fields of view, weight, power requirements, thermal requirements, command and telemetry requirements, sensitivity to or generation of contamination (e.g., electromagnetic interference, gaseous effluents, etc.), data processing and storage requirements, as well as the planned process for physically and analytically integrating them with the flight system. The testing strategy of the science payload, prior to integration with the spacecraft, should be discussed.
Note for Missions of Opportunity: This paragraph is not applicable to Missions of Opportunity that are not developing hardware.

7. Manufacturing, Integration, and Test. This section should describe the manufacturing strategy to produce, test, and verify the hardware/software necessary to accomplish the mission. It should include a description of the main processes/procedures planned in the fabrication of flight hardware, software, production personnel resources, incorporation of new technology/materials, and the preliminary test and verification program. The environmental tests planned should be discussed and proposed test margins and durations for the environmental test program specified. Part burn-in requirements that will be used for the program should also be defined. Describe the approach for transitioning from design to manufacturing and specify data products that will be used to assure producibility and adequate tooling availability.

   The approach, techniques, and facilities planned for integration, test and verification, and launch operations phases (including launch integration and processing), consistent with the proposed schedule and cost, should be described. A preliminary schedule for manufacturing, integration, and test activities, including system-level performance tests with the flight software, should be included. A description of the planned end items, including engineering and qualification hardware and software, should be included.

Note for Missions of Opportunity: Much of this paragraph may not be applicable to Missions of Opportunity that are not developing hardware. However, this paragraph does include describing the plan to produce, test and verify software. Missions of Opportunity proposals must address any flight software modifications. Discuss how flight software modifications will be tested to ensure they perform as planned.

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8. Mission Operations, Ground, and Data Systems. This section should discuss the overall Operations Plan including a block diagram of all ground and flight components, show all interfaces between Science Operations Centers (SOCs) and the Mission Operations Center (MOC) and describe what functions are performed at the SOC and MOC and the data systems necessary to support those functions. Describe the mission operations and the ground operations support required for the proposed investigation. The planned approach for managing mission operations and all flight operations support, including mission planning and scheduling, command sequence generation, uplink commanding, trajectory tracking, navigation, and telemetry downlink and analysis should be discussed. Describe the approach for emergency communications during any phase of the mission. Describe all inter-facility communications, computer security, or near real-time ground support requirements, licenses and/or approvals required, and indicate any special equipment or skills required of ground personnel. Provide a staffing plan for both mission operations and science payload operations. Proposers planning to utilize the Deep Space Mission System's (DSMS's) facilities (Deep Space Network [DSN] and Advanced Multi-Mission Operations System) are strongly advised to contact the DSMS Plans and Commitment Office during the Concept Study to better understand the options and associated costs for NASA-provided operations and communications services.

   The approach to the development of the Ground Data System, including design heritage and the use, if any, of existing facilities including Government facilities, should be described. All usage of the DSN and of any existing non-DSN facilities should be explicitly described (see *NASA's Mission Operations and Communications Services* document in the Discovery Program Library (DPL) for specific requirements and contacts) including plans for pre-launch compatibility testing. Any mission-unique facilities must be adequately described. Include a block diagram of the Ground Data System (GDS) showing the end-to-end concept (acquisition through archiving in the appropriate data archive) for operations and data flow to the subsystem level. Describe all communications, tracking, and ground support requirements; flight-ground trade studies; and integration and test plans. Describe the space/ground link spectrum requirements and the licensing approach. Proposers should contact an appropriate NASA Frequency Spectrum Management organization to ascertain licensing and frequency assignment requirements. An appropriate Spectrum Management organization is typically located in the organization providing Earth station or Tracking and Data Relay Satellite System (TDRSS) support. Describe the software design

heritage and software development approach and its relationship to the flight system software development.

Specific features incorporated into the flight and ground system design that lead to low-cost operation should be identified. The use of any existing mission operations facilities and processes should be described, as well as any new facilities required to meet mission objectives.

Note for Missions of Opportunity: this paragraph must be fully addressed.

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9. Facilities. Provide a description of any new, or modifications to existing, facilities, laboratory equipment, and ground support equipment (GSE) (including those of the team's proposed contractors and those of NASA and other U.S. Government agencies) required to execute the investigation. The outline of new facilities and equipment should also indicate the lead-time involved and the planned schedule for construction, modification, and/or acquisition of the facilities.

Note for Missions of Opportunity: address this as applicable to your proposal.

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10. Software Development Approach. Provide a Master Software List summarizing all major ground and flight software elements, characterizing function (including fault protection), estimated size, inheritance/heritage, operational platform, and responsible team member for developing each element. Describe the investigation team's plan for acquiring, inheriting or developing, testing, validating and verifying flight and ground software over all mission phases. Provide assumptions on inheritance and describe the cost basis for the software. Provide a description of the test environment for the flight software, including the fidelity and availability of the proposed simulators used for testing. In summary, this section should describe the overall software design and test approach whereas the requirements and functionality of flight and ground software should be described in Sections F.4, F.5, F.7, and F.8.

Note for Missions of Opportunity: address this as applicable to your proposal. Address all major ground and flight software elements.

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11. Product Assurance, Mission Assurance and Safety. This section should describe the process by which the product quality is assured to meet the proposer's specifications, including identification of trade studies, the parts selection strategy, and the plans to incorporate new technology. This section should also describe the product assurance plan, including plans for problem/failure reporting, inspections, quality control, parts selection and control, reliability, safety assurance, and software validation. Describe the risk mitigation efforts that address designing for long life, dormant reliability, and cold environment and radiation effects. Describe the radio science link and any ultrastable oscillator requirements and how the project plans to meet these

requirements. In addition, investigators should be aware of mission assurance topics of recent Agency-level special emphasis for all NASA missions. Such topics include Red Team Reviews, subsystem-level Failure Mode Effects Analysis, Probabilistic Risk Assessment with its subset of analysis tools, Continuous Risk Management, and Software Independent Verification and Validation.

Note for Missions of Opportunity: Much of this paragraph may not be applicable to Missions of Opportunity that are not developing flight hardware. However, Mission of Opportunity proposers should review this and address the intent as appropriate for their investigations. For instance, if using an existing spacecraft, the proposer should address how the original design of the spacecraft and it past performance demonstrates that the spacecraft system performance and expected lifetime are sufficient to cover the planned use of the spacecraft for the proposed mission of opportunity.

G. MANAGEMENT PLAN

This section sets forth the investigator's approach for managing the work, the recognition of essential management functions, and the overall integration of these functions. This section should specifically discuss the decision-making process to be used by the team, focusing particularly on the roles of the Principal Investigator (PI) and Project Manager (PM) in that process. Include a discussion of the relationship among the investigation team, the Discovery/New Frontiers Program Office (DNFPO), and NASA Headquarters. The management plan should give insight into the organizations proposed for the work, including the internal operations and lines of authority with delegations, external interfaces and relationships with NASA, major subcontractors and partners, and associated investigators. It also should identify the institutional commitment of all team members (including team members responsible for E/PO), and the institutional roles and responsibilities. The use of innovative processes, techniques, and activities by mission teams in accomplishing their objectives is encouraged; however, they should be employed only when cost, schedule, or technical improvements can be demonstrated and specific enabling assumptions are identified.

1. Team Member Responsibilities. This section should describe the roles, responsibilities, time commitment, and experience of all team member organizations and key personnel, with particular emphasis placed on the responsibilities assigned to the PI, the PM, the deputy PM, the Project Systems Engineer, and other key personnel. In addition, information should be provided which indicates what percentage of time key personnel will devote to the mission, the duration of service, and how changes in personnel will be accomplished. (Note: The experience of the PI and science team members addressed in the science investigation section does not need to be repeated in this section.)

Note for Missions of Opportunity: this section is applicable and must be addressed.

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a. Organizational Structure. The management organizational structure of the investigation team must be described in the CSR. A Work Breakdown Structure (WBS) must be provided. The CSR must describe the responsibilities of each team member organization and its role in the investigation. Each key position, including its roles and responsibilities, how each key position fits into the organization, and the basic qualifications required for each position, must be described. A discussion of the unique or proprietary capabilities that each member organization brings to the team, along with a description of the availability of personnel at each partner organization to meet staffing needs should be included. The contractual and financial relationships between team partners should be discussed.

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Summarize the subcontracting plan and its effect on the technical, management, and cost feasibility of the investigation and refer to supporting detail in the subcontracting plan which is provided in Section L.

Summarize the relevant institutional experience in this section, and refer to supporting detail included in Section L, Relevant Experience and Past Performance. If experience for a partner is not equivalent to, or better than, the requirements for the proposed mission, explain how confidence can be gained that the mission requirements will be accomplished within cost and schedule constraints.

b. Experience and Commitment of Key Personnel. Provide a history of experience explaining the relationship of the previous experience to each key individual's role; include the complexity of the work and the results.

i. Principal Investigator. The role(s), responsibilities, and time commitment of the Principal Investigator should be discussed. Provide a reference point of contact, including address, email address, and phone number.

ii. Project Manager and Deputy Project Manager. The roles, responsibilities, time commitment, and experience of the Project Manager and Deputy Project Manager should be discussed. Provide reference points of contact for the Project Manager and Deputy Project Manager, including addresses, email addresses, and phone numbers.

iii. Other Key Personnel. The roles, responsibilities, time commitments, and experience of other key personnel in the investigation, including Co-Investigators, should be described.

2. Management Processes and Plans. This section should describe the management processes and plans necessary for the logical and timely pursuit of the work (including E/PO), accompanied by a description of the work plan. This section should also describe the proposed methods of hardware and

software acquisition. The management processes which the investigator team proposes, including the relationship between organizations and key personnel should be discussed, including the following, as applicable: systems engineering and integration; requirements development; configuration management; schedule management; team member coordination and communication; progress reporting, both internal and to NASA; performance measurement; and resource management. This discussion should include all phases of the mission including preliminary analysis, technical definition, the design and development, and operations phases, along with the expected products and results from each phase. Describe the systems engineering approach that will be utilized in the definition, flowdown, tracking, and verification of design requirements, resource allocation and control, interface requirements and configuration and software configuration control. Unique tools, processes, or methods which will be used by the investigation team should be clearly identified and their benefits discussed. All project elements should be covered to assure a clear understanding of project-wide implementation.

Note for Missions of Opportunity: address this as applicable to your proposal. Discuss the Management Processes and Plans for the work that you are proposing.

3. NEPA Compliance and Approval. If an RHU is proposed, then two separate, yet related, processes of NEPA Compliance and Launch Approval shall be discussed. The requirement to launch an RHU shall be incorporated in this discussion. A clear understanding of each process shall be presented, including the necessary documents to be prepared, reviews to be conducted, timing of the key process milestones, and identification of responsible agencies and organizations. Any project-unique risks posed by the investigation's implementation approach must be identified. A proposed schedule, including all key milestones, shall be presented. Any exceptions to traditional NEPA/Launch Approval milestone scheduling required to match the schedules to the investigation's implementation constraints shall be noted.
Note for Missions of Opportunity: this is not applicable to the Missions of Opportunity.

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4. Schedules. A detailed project schedule with the critical path(s) clearly delineated is required. The schedule and workflow for the complete mission lifecycle must be clearly defined, and the method and tools to be used for internal review, control, and direction discussed. Schedules for all major activities, interdependencies between major items, deliveries of end items, critical paths, schedule margins, and long-lead procurement needs (defined as hardware and software procurements required before the start of Phase C/D) should be clearly identified and discussed. Any essential technology developments and SEO/TDO development and decision points as well as major Engineering Test Units should be included. Provide a level 2 software build and delivery schedule that clearly indicates the relationship of the deliveries to the system integration and test activities from the start of test bed

level testing all the way through final spacecraft level tests prior to launch. This should be accompanied by a listing of the functions contained in each build. Schedules are to be provided in MS Project format.

Note for Missions of Opportunity: If a MO is using an existing spacecraft that is in Phase E., the MO may or may not be in Phase E depending on the type and magnitude or items that need to be developed for the proposed MO. The project schedule should reflect the planned development activities (if any) by the MO. If the MO proposal includes significant development of flight software or other items, then those items need to go through a development process which may include a CDR and so would not be in Phase E. If the MO requires development of Flight Software modifications, or new data analysis and processing tools, or a new ground system or modifications to an existing ground systems, these items should be discussed and costed in Phase B and/or C/D as is appropriate to the topic and the significance of the modification. As a guideline put the item in the phase it would have been if it were part of a full mission development.

5. Risk Management. This section should describe the approach to, and plans for, risk management to be taken by the team, both in the overall mission design and in the individual systems and subsystems. Plans for using standard risk management tools, especially fault tree analysis, probabilistic risk assessments, and failure modes and effects analyses, should be described. The role of the Project Systems Engineer in risk management should be discussed. Particular emphasis should be placed on describing how the various elements of risk, including new technologies used, will be managed to ensure successful accomplishment of the mission within cost and schedule constraints. Investigations dependent on new technology will be penalized for risk if adequate plans to ensure success of the investigation are not described. At least the top three risks and their mitigation plans must be discussed. Risk management for SCs, SEOs or TDOs must also be addressed.

   A summary of reserves in cost and schedule should be identified by Phase and project element and year. The proposer's rational for the proposed cost and schedule reserve must be discussed. The specific means by which integrated costs, schedule, and technical performance will be tracked and managed should be defined. Specific reserves and the timing of their application should be described. Management of the reserves and margins, including who in the management organization manages the reserves and when and how the reserves are released, must be discussed. This should include the strategy for maintaining reserves as a function of cost-to-completion. All funded schedule margins should be identified. The relationship between the use of such reserves, margins, potential descope options, and their effect on cost, schedule, and performance should be fully discussed. When considering potential descope options, consider the investigation as a total system including instrument(s), spacecraft, ground system, launch services, and operations.

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6. Government Furnished Property, Services, Facilities, etc. This section should clearly delineate the Government-furnished property, services, facilities, etc. required to accomplish all phases of the mission.

Note for Missions of Opportunity: address this as applicable to your proposal.

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7. Reviews. This section should list the major project reviews expected to be conducted during the project's life cycle and the approximate time frame of each. The objective of each review should be indicated. A list of typical Flight Project reviews can be found in 7120.5. Allowance should also be made for government-initiated reviews including Confirmation Assessments as well as Independent Assessment Reviews, to be conducted on an approximate annual basis. The DNFPO will plan to conduct these reviews in conjunction with planned Project reviews (e.g., PDR, CDR, etc.). It should be noted that regular reviews of the progress of the E/PO component of the missions should be held in the same way that progress on the scientific and technical aspects is reviewed.

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8. Reporting. This section should clearly describe the approach to reporting progress to the Government and indicate the progress reviews the Government should attend to provide independent oversight. The process, including the individual or organization responsible for reporting integrated cost, schedule, and technical performance, should be discussed. Planned project status reporting should include inputs to the monthly presentations to the governing Program Management Council (PMC), monthly status reporting to the DNFPO, and, after the Project Critical Design Review (CDR), a brief weekly summary of progress via a web-based NASA Science Mission Directorate reporting site.

Note for Missions of Opportunity: address this as applicable to your proposal.

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9. Software Independent Verification and Validation (IV&V). This section should describe the plan to comply with NPR 7120.5C and NPD 2820.1C for software IV&V. Discussion of the plan to task the NASA IV&V Facility in Fairmont, West Virginia to manage the conduct of IV&V for appropriate project-produced flight and ground software is required. The NASA IV&V Facility uses an on-line self assessment process, available at http://ivvcriteria.ivv.nasa.gov/, as a discussion starting point to understand risk and specific software development characteristics for the mission.

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Projects must negotiate the use of the NASA IV&V Facility but don't pay for it. The NASA IV&V Facility is to be considered as a provider of extra IV&V not a replacement for the project IV&V.

Note for Missions of Opportunity: address this as applicable to your proposal.

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For Missions of Opportunity, address the areas above, as applicable. Also describe how the investigation's organizational interfaces with other investigations and plans for reporting to NASA, and the investigation development plan and how it fits in the development plan for other investigations on the host mission.

H. TECHNICAL DEFINITION (PHASE B) PLAN

This section should describe the plans and products for the technical definition phase (Phase B) of the Project. This section should identify the key mission tradeoffs and options to be investigated during the Phase B and should identify those issues, technologies, and decision points critical to mission success – including acquisition of long-lead items and the associated funding requirements. These plans should include a detailed schedule and define the products (including a Project Plan and Level 1 Requirements) and the schedule for their delivery.

Note for Missions of Opportunity: address this as applicable to your proposal. If you do not have a phase B, then do not address.

I. EDUCATION AND PUBLIC OUTREACH

The education and public outreach should provide a summary of the benefits offered by the mission beyond the scientific benefits brought by obtaining and analyzing the desired scientific data.

Note for Missions of Opportunity: this section is applicable and must be addressed.

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1. Education and Public Outreach Activities. This section should build upon and extend the discussion of E/PO activities given in the proposal. As noted earlier in these Guidelines, it is expected that the Concept Study plans will be substantially refined and expanded beyond the level of detail contained in the original proposal. Plans for product development and dissemination, contributions to the training of underserved and/or underutilized groups in science and technology, arrangements with partners, schedules and budgets for activities, etc., are to be defined in sufficient detail that they can be evaluated at an appropriate level of depth. Where appropriate, references should be made to the Management Plan and other relevant sections for information on how the work is to be arranged, directed, implemented, reviewed, and reported. Letters of support/commitment from partners/subcontractors and resumes from key E/PO personnel should be included as appendices to the CSR.

2. Student Collaboration (Optional). The Concept Study may include a Student Collaboration (SC) that involves development of an instrument, investigation of scientific questions, analysis and display of data, development of supporting hardware or software, and/or other aspects of the mission. The activities may involve flight, suborbital, or ground systems. A Concept Study that includes a Student Collaboration must fully describe the SC educational impact in the context of workforce development, as well as technical, maturity, processes, and mission risks. It must provide detailed plans for implementing the SC activities, including identification of and formal commitment from partner institutions, development schedule of the SC, decision points for determining SC readiness. An SC should aim to add value to the science or engineering of the mission, but the study must describe how the SC will be planned so that the baseline science investigation is not compromised in the event that the SC component is not funded, encounters technical, schedule, or cost problems, or fails in flight. The team shall provide an adequate plan for mentoring and oversight of students to maximize the opportunity for teaching, learning, and success in contributing to the mission. The Student Collaboration is a part of the Education and Public Outreach effort and must be clearly identified as an E/PO element. The SC may have a separate 5 pages allocated to it to discuss its approach and implementation. The criteria to be used to evaluate the E/PO component and a discussion of those criteria is given in the document Explanatory Guide to the NASA Office of Space Science Education and Public Outreach Evaluation Criteria (March 2004) which may be found by linking through the E/PO Web site at the URL http://spacescience.nasa.gov. The Student Collaboration and the balance of the E/PO effort are evaluated independently and both must completely address the E/PO Evaluation Criteria. Although the cost of the SC must be included under the cost cap, the cost of the SC must be identified separately from the proposed investigation

Questions and/or comments and suggestions about the SMD E/PO program are welcome; they may be directed to Dr. Larry P. Cooper (telephone: (202) 358-1531; E-mail: larry.p.cooper@nasa.gov).

J. COST PLAN FOR MISSION PHASES A THROUGH E

The CSR cost proposal should provide information on the anticipated costs for phases A through E for the preferred baseline launch date or for all proposed phases for a MO. For full missions, a detailed cost proposal is required for Phase B **(For MO proposals, a detailed cost proposal is required for all proposed phases.)**. For full missions, cost estimates are required for the follow-on phases (C/D and E), including a description of the estimating techniques used to develop the cost estimates. Specific information that would better enable NASA to validate costs (e.g., WBS level 3 data) may be provided as an appendix - see Section L). A discussion of the basis of estimate should be provided with a discussion of heritage and commonality with other programs. Quantify and explain any cost savings that result from heritage. All costs, including all contributions made to the investigation, should be included.

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Full cost accounting for NASA facilities and personnel proposed must be submitted as directed in section 5 of the AO.
Note for Missions of Opportunity: this section is applicable and must be addressed.

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Proposers shall outline their reserves plan indicating the appropriate amounts of technical, schedule, and cost reserves based on design maturity and flight heritage. All investigations must include adequate reserves at every phase of the mission. *In particular, all selected missions or MOs will be required to show a budget reserve posture at the end of phase B commensurate with the risk associated with the implementation of the mission, but no less than 25% of cost to go for costs through the end of Phase D, excluding the cost of the ELV.* **(Note for Mission of Opportunity Proposals: this requirement is waived. MO proposers must propose adequate reserve and justify the proposed reserve level.)** A cost reserve for Phase E must also be included as appropriate. The uncertainties in the baseline cost estimate must be discussed. A confidence level and high and low cost values around the baseline proposed cost estimate appropriate to the level of uncertainty must be discussed. A discussion justifying the confidence level and the high and low values must be provided.

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Proposers should complete a summary of total mission cost by fiscal year as shown in **Figure 1,** Total Mission Cost Funding Profile. The purpose of this summary is to (1) provide detailed insight into project costs by cost element and (2) provide a basis for comparison of the project proposed cost with the evaluation team's independent cost analysis. It presents all costs for the project *on one page,* by project phase (A through E), and by fiscal year. If obligation authority in excess of identified costs is required, the proposal must also indicate the authority needed by year.

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In addition, for each phase of the investigation (A, B, C/D, and E as appropriate) a Time Phased Cost Breakdown for each Work Breakdown Structure (WBS) element, as shown in **Figure 2**, must be completed. Use only the line items shown in Figure 2 that are relevant for each phase of the project. The purpose of this set of Figures is to provide detailed insight into how the project allocates funding during each phase of work.

The cost of the entire project should be summarized on one page and presented in the format shown in **Figure 3**. The purpose of Figure 3 is to provide detailed insight into project costs by cost element. Identify each reserve amount to the lowest level consistent with the proposed reserve management strategy. For example, if each subsystem manager will have spending authority over a reserve for the subsystem, each such amount should be identified separately. If more convenient, the reserve details may be shown in a separate table, with totals reported as shown in Figure 3. Show costs for all development elements by recurring and non-recurring components in the format of **Figure 4**. Show costs (NASA SMD and contributed) associated with each Co-Investigator in the format of **Figure 5**.

Proposers should include all contributions provided by NASA Centers, including Civil Servant services, as well as the cost for the use of Government facilities and equipment on a full-cost accounting basis. All direct and indirect costs associated with the work performed at NASA Centers should be fully costed and accounted for in the proposal and summarized using the template provided in **Figure 6**. The purpose of this data is twofold: 1) to determine those costs that are included in the NASA SMD cost but are not funded out of the Discovery program, and 2) to determine civil service contributions that are not included in the NASA SMD cost. Teams should work with their respective NASA Centers to develop estimates for these costs.

Note that the definitions for cost element terms shown in the cost figures are provided in the *Program Cost Elements* document in the DPL.

The inflation index provided in Appendix B (Table B-3) of the AO should be used to calculate all real-year dollar amounts, unless an industry forward pricing rate is used. Proposers should use DCAA-approved forward pricing agreements when they exist. If something other than the provided inflation index is used, the rates used should be documented.

All costs shall include all burdens and profit/fee in real-year dollars by fiscal year, assuming the inflation rates used by NASA (listed in Table B3 of the AO) or specifically identified industry forward pricing rates.

Note for Missions of Opportunity: this section is applicable and must be addressed. MO proposers must submit costs for the phases they are proposing. For example, a MO proposer may only have a Phase E, or Phase C/D and Phase E. For all phases in a MO proposal, provide the cost information at the level described in section 1 below (titled Phase B cost Proposal).

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1. Phase B Cost Proposal. This section provides a detailed cost proposal for performing the Phase B study. Detailed plans for the study should be described, but reference may be made to the Technical Approach and Management sections of the proposal, as appropriate.

   a. Contract Pricing Proposal. Cost or pricing data is required for Phase B. Completed cost or pricing data must be included with the CSR proposal for each organization participating in the Phase B study and must be signed by each organization's authorized representative. This requirement may be satisfied with one form provided that all institutions involved in the Phase B study are included with the appropriate signatures. The contract pricing proposal for Phase B may be provided as an appendix (see section K).

   b. Work Breakdown Structure. A Work Breakdown Structure (WBS) should be included for Phase B. The structure of the WBS should be consistent with the plans set forth in the Technical Approach and Management

sections of the proposal and the Statement of Work provided as an Appendix to the proposal.

c. Workforce Staffing Plan. Provide a workforce-staffing plan that is consistent with the WBS. This workforce-staffing plan should include all team member organizations and should cover all management, technical (scientific and engineering), and support staff. The workforce-staffing plan should be phased by month. Time commitments for the PI, PM, Deputy PM, and other key personnel should be clearly shown.

d. Proposal Pricing Technique. Describe the process and techniques used to develop the Phase B cost proposal. Provide a description of the cost-estimating model(s) and techniques used in the Phase B cost estimate. Discuss the heritage of the models and/or techniques applied to this estimate, including any known differences between missions contained in the model's data base and key attributes of the proposed mission. Include the assumptions used as the basis for the Phase B cost and identify those which are critical to cost sensitivity in the investigation. Identify any "discounts" assumed in the cost estimates for business practice initiatives or streamlined technical approaches. Describe how these have been incorporated in the cost estimate and will be managed by the investigation team.

e. Phase B Time-Phased Cost Summary. Provide a summary of the total Phase B costs consistent with Figure 2. Phase B costs also appear in Figure 3, and in Figure 4 if development work is planned during Phase B. The Phase B cost summary should be developed consistent with the WBS and should include all costs to NASA along with all contributed costs. The Phase B time phased cost summary should be phased by month.

f. Cost Elements Breakdown. To effectively evaluate the Phase B cost proposals, NASA requires costs and supporting evidence stating the basis for the estimated costs. The proposal will include, but is not limited to:
   i. Direct Labor.
      (1) Explain the basis of labor-hour estimates for each of the labor classifications.
      (2) State the number of productive work-hours per month.
      (3) Provide a schedule of the direct labor rates used in the proposal. Discuss the basis for developing the proposed direct labor rates for the team member organizations involved; the forward-pricing method (including midpoint, escalation factors, anticipated impact of future union contracts, etc.); and elements included in the rates, such as overtime, shift differential, incentives, allowances, etc.
      (4) If available, submit evidence of Government approval of direct labor rates for proposal purposes for each labor classification for the proposed performance period.

(5) If Civil Servant labor is to be used in support of the Phase B study, but is not to be charged directly to the investigation, then this labor must be considered as a contribution by a domestic partner, subject to the same restrictions as other contributions by domestic or foreign partners. A discussion of the source of funding for the Civil Servant contributions must be provided.

ii. Direct Material. Submit a summary of material and parts costs for each element of the WBS.

iii. Subcontracts. Identify fully each effort (task, item, etc. by WBS element) to be subcontracted, and list the selected or potential subcontractors, locations, amount budgeted/proposed and types of contracts. Explain the adjustments, if any, and the indirect rates (or burdens) applied to the subcontractors' proposed amounts anticipated. Describe fully the cost analysis or price analysis and the negotiations conducted regarding the proposed subcontracts.

iv. Other Direct Costs.

(1) Travel, Relocation, and Related Costs. Provide a summary of the travel and relocation costs including the number of trips, duration, and purpose of the trips.

(2) Computer. Provide a summary of all unique computer-related costs.

(3) Consultants. Indicate the specific task area or problem requiring consultant services. Identify the proposed consultants, and state the quoted daily rate, the estimated number of days and associated costs (such as travel), if any. State whether the consultant has been compensated at the quoted rate for similar services performed in connection with Government contracts.

(4) Other. Explain and support any other direct costs included in the Phase B proposal in a manner similar to that described above.

v. Indirect Costs.

(1) List all indirect expense rates for the team member organizations. Indirect expense rates (in the context of this AO) include labor overhead, material overhead, general and administrative (G&A) expenses, and any other cost proposed as an allocation to the proposed direct costs.

(2) If the proposal includes support services for which off-site burden rates are used, provide a schedule of the off-site burden rates. Include a copy of the company policy regarding off-site vs. on-site effort.

(3) If available, submit evidence of Government approval of any/all projected indirect rates for the proposed period of performance. Indicate the status of rate negotiations with the cognizant Government agency, and provide a comparative listing of approved bidding rates and negotiated actual rates for the past five (5) fiscal years.

(4) Discuss the fee arrangements for the major team partners.

2. Design/Development (Phase C/D) Cost Estimate. This section provides a cost estimate for performing the Design/Development Phase (Phase C/D) portion of the mission. The Phase C/D cost estimates should correlate with the plans set forth in the Science, Technical Approach, and Management sections of the proposal. In completing this section, the following guidelines will apply:

   a. Work Breakdown Structure. A Work Breakdown Structure (WBS) should be included for Phase C/D. The WBS shall be described to the subsystem level (Attitude Control System, Propulsion System, Structure and Mechanisms, etc.) for the spacecraft and to the instrument level for the payload. All other elements of the WBS should be to the major task level (Project Management, Systems Engineering, Ground Support Equipment, education and public outreach, etc.).

   b. Cost Estimating Technique. Describe the process and techniques used to develop the Phase C/D cost estimate. Provide a description of the cost-estimating model(s) and techniques used in the Phase C/D cost estimate. Discuss the heritage of the models applied to this estimate including any known differences between missions contained in the model's database and key attributes of the proposed mission. Include the assumptions used as the basis for the Phase C/D cost and identify those that are critical to the cost sensitivity in the investigation. Identify any "discounts" assumed in the cost estimates for business practice initiatives or streamlined technical approaches and the basis for these discounts. Describe how these have been incorporated in the cost estimate and will be managed by the investigation team.

   c. Workforce Staffing Plan. Provide a workforce-staffing plan (including civil service) that is consistent with the WBS. This workforce-staffing plan should include all team member organizations and should cover all management, manufacturing, technical (scientific and engineering), education and public outreach, and support staff. The workforce-staffing plan should be phased by fiscal year. Time commitments for the PI, PM, and other key personnel should be clearly shown.

   d. Phase C/D Time-Phased Cost Summary. Provide a summary of the total Phase C/D costs consistent with Figure 2. The Phase C/D cost summary should be developed consistent with the WBS and should include all costs to NASA, along with all contributed costs. The Phase C/D time-phased cost summary should be phased by fiscal year. Also report Phase C/D costs in Figures 3 and 4. Phase C/D extends 30 days beyond launch so be sure to account for all costs for this period, including tracking support and mission operations.

3. Mission Operations (Phase E) Cost Estimate. This section provides a cost estimate for performing the Mission Operations for Phase E. In completing

this section, the guidelines for Phase C/D apply. Proposers may refer to the information provided in *NASA's Mission Operations and Communications Services* document in the DPL for mission operations and communications costs, if NASA systems are proposed. Since the best possible cost estimates are desired, the contacts listed in the subject document should be consulted to assure accuracy as well as credibility.

4. Cost Estimate for any SEO, TDO, or SC. Provide a cost estimate for any SEO, TDO, or SC and reserves in this section. Such costs are included within the cost cap.

5. Cost Estimate for E/PO. This section should summarize the estimated costs to be incurred in Phases A through E of the investigation for the E/PO component. Provide detailed E/PO cost information in the format of E/PO Template 1, 2, and 3. Summary E/PO cost information must provided in Figures 1-6 and be consistent with the E/PO Template information and the activities, products, programs, partnership arrangements, etc., defined in Section I.

6. Total Mission Cost (TMC) Estimate. This section should summarize the estimated costs to be incurred in Phases A through E including: Concept Study (Phase A); Technical Definition (Phase B); Design and Development (Phase C/D); Mission Operations and Data Analysis (Phase E); launch vehicle, upper stages, and launch services; DSN and other ground system costs; and cost of activities associated for social or educational benefits (if not incorporated in any of Phases A through E). Figure 1 should be used to summarize these costs. The total mission cost estimate should be developed consistent with the Work Breakdown Structure. Detailed plans for any aspects of the mission not discussed elsewhere in the CSR should be discussed here. The funding profile should be optimized for the mission. Contributions not included in the NASA SMD cost should be clearly identified as separate line items.

Note that immediately following downselection, NASA will award a letter contract based upon the detailed estimated costs for Phase B for full Missions and all phases for a MO proposal and will request a formal cost proposal with detailed cost information for the subsequent mission phases. The contractor will be requested to submit a formal cost proposal based upon the Federal Acquisition Regulation (FAR) Part 15. The instructions and format for submission of this proposal are found in FAR Part 15.403-5 and Table 15.2. It is essential that the cost elements proposed in the formal contract proposal for contract award be traceable to the cost proposal provided in the CSR. Any changes in costs from the concept study proposal should be described in detail. The definitized contract will include an option provision for Phase C/D and E with a not-to-exceed amount for each phase.

Figure 1

TOTAL MISSION COST FUNDING PROFILE

FY Costs in Real Year Dollars (to nearest thousand), Totals in RY and Fixed Year '06 Dollars

	Formulation*		Subtotal Formulation		Implementation*			Subtotal Implementation		TOTAL LIFE CYCLE	
	FY1	Fyx	RY $	FY06$	FY1	…	FYz	RY $	FY06$	RY $	FY06$
Cost Element **											
Start to Launch + 30 Days (Phases A/B/C/D)	**Enter each cost element**										
Phase A Concept Study											
Project Management/Mission Analysis/Systems Engineering											
Instrument A											
Instrument B											
Instrument …											
Instr. Integration, Assembly and Test											
Subtotal - Instruments											
Spacecraft bus											
S/C Integration, Assembly and Test											
Other Hardware Elements [1]											
Launch Ops (Launch + 30 days)											
Subtotal - Spacecraft											
Science Team Support											
Pre-Launch GDS/MOS Development											
DSN/Tracking											
Other[2]											
Subtotal Phases A-D before Reserves											
Instrument Reserves											
Spacecraft Reserves											
Other Reserves											
Total Phases A/B/C/D											
Launch + 30 Days to End of Mission (Phase E)	**Enter each cost element**										
Mission Operations & Data Analysis (including Project Management)											
DSN/Tracking											
Other [2]											
Subtotal Phase E before Reserves											
Reserves											
Total Phase E											
SEO/TDO/SC (optional)											
Reserves											
Total SEO/TDO/SC											
Launch Services											
Total SMD Cost Phase A-E											
Contributions [2]											
Total Contributions											
								Total Mission Cost =			

* Note: Formulation = Phase A + B, Implementation = Phase C + D + E

** See Cost Elements document in the Discovery Program Library

[1] Other Hardware Elements: Probes, Sample Return Canister, Etc.

[2] Specify each item on a separate line; include Education and Public Outreach, facilities, etc.

Note: Funding for Phase F, Extended Mission activities such as PSP, DAP or GO is outside the AO cost cap and will not be selected as part of the Phase A study.

FIGURE 2
(Phased costs in Real Year Dollars, Totals in Real Year and FY2006 Dollars)

TIME PHASED COST BREAKDOWN BY WBS AND MAJOR COST CATEGORY					
WBS/Cost Category Description	FY1	FY2	• • •	Total (RY$)	Total (FY2006$)
Total Direct Labor Cost	$	$	$	$	$
WBS 1.0 Management					
WBS 2.0 Spacecraft					
WBS 2.1 Structures & Mechanisms					
WBS 2.2 Propulsion					
etc.					
Total Subcontract Costs	$	$	$	$	$
WBS # and Description					
:					
etc.					
Total Materials & Equipment Cost	$	$	$	$	$
WBS # and Description					
:					
etc.					
Total Reserves	$	$	$	$	$
WBS # and Description					
:					
etc.					
Total Other Costs	$	$	$	$	$
WBS # and Description					
:					
etc.					
Fee					
E/PO, TDO,SEO,SC Other (Specify)					
Total Contract Cost	$	$	$	$	$
Total Other Costs to NASA SMD	$	$	$	$	$
Launch Services					
Ground Segment					
E/PO, Other (Specify)					
Total Contributions (Non-U.S. or U.S.)	$	$	$	$	$
Organization A:					
WBS # and Description					
etc.					
Organization B:					
WBS # and Description					
etc.					
TOTAL COST FOR PHASE	$	$	$	$	$

Figure 3 Fiscal Year Costs in Fiscal Year 2006 Dollars (to nearest thousand)
(Totals in Real Year and Fiscal Year 2006 Dollars)

Cost Element	FY1	FY2	FY3	...	FYn	Total (FY2006$)	Total (RY$)
Phase A							
Reserves							
Total Phase A							
Phase B							
Reserves							
Total Phase B							
Phase C/D							
Instrument A							
Instrument B							
Instr Integ, Assy & Test							
Subtotal – Instruments							
Spacecraft Bus							
Spacecraft Integ, Assy & Test							
Other Hardware Elements							
Launch Ops							
Subtotal – Spacecraft							
Proj Mgmt/Miss Analysis/Sys Eng							
Science Team Support							
Prelaunch GDS/MOS Development							
E/PO, Other*							
Subtotal Phase C/D before Reserves							
Instrument Reserves							
Spacecraft Reserves							
Other Reserves							
Total Phase C/D							
Phase E							
MO&DA							
Tracking Services (Earth Station or TDRSS)							
E/PO, Other*							
Subtotal Phase E before Reserves							
Reserves							
Total Phase E							
Launch Services							
Total NASA SMD Cost	$	$	$	$	$	$	$
Contributions*							
Total Contributions	$	$	$	$	$	$	$
					Total Mission Cost		$

*Specify each item on a separate line; include Education & Public Outreach, facilities, SEO, TDO, SC etc.

Figure 4
Phase C/D Development Costs
in Real Year Dollars (to nearest thousand)

Cost Element	Non-Recurring	Recurring	Total (RY$)	Total (FY2006$)
Instrument A*				
Instrument B*				
Instrument n*				
Subtotal – Instruments				
Structure and Mechanisms				
Attitude Control				
Power				
Subsystem n				
Subtotal - Spacecraft Bus				
Any other elements (specify)*				
Subtotal - Other elements				
Total NASA SMD Development Cost				

* Other elements: probes, sample return canister, etc. Specify each instrument by subsystem/components where possible

FIGURE 5
CO-INVESTIGATOR COMMITMENT AND COST
FUNDING PROFILE TEMPLATE
(FY costs in Real Year Dollars, Totals in Real Year and FY2006 Dollars)

	Phase B	Phase C/D	Phase E	Total (Real Year)	Total (FY 2006)
NASA SMD Cost					
Co-I #1 Name/Organization					
Percent Time					
Cost					
Co-I #2 Name/Organization					
Percent Time					
Cost					
Co-I #n Name/Organization					
Percent Time					
Cost					
Total NASA SMD Co-I Cost					
Contributions					
Co-I #1 Name/Organization					
Percent Time					
Cost					
Co-I #2 Name/Organization					
Percent Time					
Cost					
Co-I #n Name/Organization					
Percent Time					
Cost					
Total Contributed Co-I Cost					

FIGURE 6
NASA CIVIL SERVICE COSTS
FUNDING PROFILE TEMPLATE
(FY costs in Real Year Dollars, Totals in Real Year and FY2006 Dollars)

Item	FY1	FY2	FY3	FY4	FY5	FYn	...	Total (Real Yr.)	Total (FY 2006)
Workforce	$	$	$	$	$	$	$	$	$
- NASA Center A									
- NASA Center B									
- etc.									
Facilities	$	$	$	$	$	$	$	$	$
- NASA Center A									
E/PO, Other*	$	$	$	$	$	$	$	$	$
- NASA Center A									
NASA Civil Service Costs included in NASA SMD Cost	$	$	$	$	$	$	$	$	$
Contributions by NASA Centers									
Workforce	$	$	$	$	$	$	$	$	$
- NASA Center A									
- NASA Center B	$	$	$	$	$	$	$	$	$
- etc.	$	$	$	$	$	$	$	$	$
Facilities									
- NASA Center A									
E/PO, Other*									
- NASA Center A									
Contributed NASA Civil Service costs	$	$	$	$	$	$	$	$	$
						Mission Totals			$

*Specify each item on a separate line.

E/PO Template #1

E/PO Program Budget

(FY costs in Real Year Dollars, Totals in Real Year and FY 2006 Dollars)

	FY1	FY2	FY3	FYn	Total (Real Yr.)	Total (FY 2006)
Personnel						
Subcontract #1						
Subcontract #2						
Subcontract #n						
Consultants						
Equipment						
Supplies						
Travel						
Other Direct Costs						
Facilities						
Administration						
Other Indirects						
Subtotal						
Cost Sharing						
TOTAL						

INSTRUCTIONS FOR E/PO BUDGET SUMMARY – TEMPLATE #1

Provide, as attachments, detailed computations of all estimates in each cost category with narratives as required to fully explain each proposed cost as follows.

1. Personnel: Attachments must list the number and titles of personnel, amounts of time to be devoted to the project, and rates of pay including salaries, wages, and fringe benefits.
2. Subcontracts/Partners/Co-I Institutions: Attachments must describe the work to be subcontracted, estimated amount, recipient (if known), and the reason for subcontracting. Enter the annual totals on this budget summary page. In addition, complete a more detailed budget summary form describing the subcontractor's/partner's/Co-I institution's use of NASA funds that the proposer requested through this solicitation (see Template #2 format).
3. Consultants: Identify consultants to be used, why they are necessary, the time (number of days) they will spend on the project, and quoted daily rates of pay. State whether the consultant has been compensated at the quoted rate for similar services performed in connection with Government contracts.
4. Equipment: List separately. Explain the need for items costing more than $5,000. Describe basis for estimated cost. General purpose equipment is not allowable as a direct cost unless specifically approved by the NASA Contracting Officer. Any equipment purchase requested to be made as a direct charge under this award must include the equipment description, how it will be used in the conduct of the work proposed and why it cannot be purchased with indirect funds.
5. Supplies: Provide general categories of needed supplies, the method of acquisition, and the estimated cost.
6. Travel: Describe the purpose of the proposed travel in relation to the contract and provide the basis of estimate, including information on destination, number of trips, and number of travelers where known.
7. Other Direct Costs: Enter the total of direct costs not covered by 1 through 6. Attach an itemized list explaining the need for each item and the basis for the estimate.
8. Facilities and Administration (F&A) Costs: Identify F&A cost rate(s) and base(s) as approved by the cognizant Federal agency, including the effective period of the rate. Provide the name, address, and telephone number of the Federal agency official having cognizance. If unapproved rates are used, explain why, and include the computational basis for the indirect expense pool and corresponding allocation base for each rate.
9. Other Indirects: Enter the total of indirect costs not covered by 8. Attach an itemized list explaining the need for each item.
10. Subtotal: Enter the sum of items 1 through 9.
11. Cost Sharing: Enter any amount proposed. If cost sharing is based on specific cost items, identify each item and amount in an attachment.
12. Total: Enter the total after subtracting item 11 from item 10.

E/PO Template #2

Subcontract Budgets

(Costs in Real Year Dollars, Totals in Real Year and FY 2006 Dollars)

	Subcontract #1	Subcontract #2	Subcontract #n
Personnel			
Consultants			
Equipment			
Supplies			
Travel			
Other Direct Costs			
Facilities			
Administration			
Other Indirects			
Subtotal			
Cost Sharing			
TOTAL (Real Yr.)			
TOTAL (FY)			

INSTRUCTIONS FOR E/PO BUDGET SUMMARY – TEMPLATE #2

Provide, as attachments, detailed computations of all estimates in each cost category with narratives as required to fully explain each proposed cost as follows.

1. Personnel: Attachments must list the number and titles of personnel, amounts of time to be devoted to the project, and rates of pay including salaries, wages, and fringe benefits.
2. Consultants: Identify consultants to be used, why they are necessary, the time (number of days) they will spend on the project, and quoted daily rates of pay. State whether the consultant has been compensated at the quoted rate for similar services performed in connection with Government contracts.
3. Equipment: List separately. Explain the need for items costing more than $5,000. Describe basis for estimated cost. General purpose equipment is not allowable as a direct cost unless specifically approved by the NASA Contracting Officer. Any equipment purchase requested to be made as a direct charge under this award must include the equipment description, how it will be used in the conduct of the work proposed and why it cannot be purchased with indirect funds.
4. Supplies: Provide general categories of needed supplies, the method of acquisition, and the estimated cost.
5. Travel: Describe the purpose of the proposed travel in relation to the project and provide the basis of estimate, including information on destination, number of trips, and number of travelers where known.
6. Other Direct Costs: Enter the total of direct costs not covered by 1 through 5. Attach an itemized list explaining the need for each item and the basis for the estimate.
7. Facilities and Administration (F&A) Costs: Identify F&A cost rate(s) and base(s) as approved by the cognizant Federal agency, including the effective period of the rate. Provide the name, address, and telephone number of the Federal agency official having cognizance. If unapproved rates are used, explain why, and include the computational basis for the indirect expense pool and corresponding allocation base for each rate.
8. Other Indirects: Enter the total of indirect costs not covered by 7. Attach an itemized list explaining the need for each item.
9. Subtotal: Enter the sum of items 1 through 8.
10. Cost Sharing: Enter any amount proposed. If cost sharing is based on specific cost items, identify each item and amount in an attachment.
11. Total Estimated Costs: Enter the total after subtracting item 10 from item 9.

E/PO Template #3

Key Personnel

(Percent Time Committed/Direct Costs, Including Benefits,
in Real Year Dollars, Totals in Real Year and FY 2006 Dollars)

	FY1	FY2	FY3	FYn	Total (Real Yr.)	Total (FY 2006)
Institution 1						
PI (% time)						
PI (direct cost)						
E/PO lead (% time)						
E/PO (direct cost)						
Institution 2						
PI (% time)						
PI (direct cost)						
E/PO lead (% time)						
E/PO (direct cost)						
Institution n						
PI (% time)						
PI (direct cost)						
E/PO lead (% time)						
E/PO (direct cost)						

INSTRUCTIONS FOR E/PO BUDGET SUMMARY – TEMPLATE #3

Workforce staffing plan for key personnel must be phased by fiscal year. In tabular form, the Workforce Table for Key Personnel must give the names and intended work commitment for the mission PI and key E/PO personnel of the proposed project both in time (rounded to the nearest 0.01 of a Work Year typically of 1880 hours) and salary (without addition of overhead or fees - rounded to the nearest $1K) for each year of the proposed period of performance.

K. PLANS FOR PHASE F, EXTENDED MISSION, INCLUDING PARTICIPATING SCIENTIST PROGRAM (PSP), DATA ANALYSIS PROGRAM (DAP), AND/OR GUEST OBSERVER PROGRAM (GO) (OPTIONAL)

Phase I proposal selection of missions and missions of opportunity were made primarily on the Merit of the baseline proposed science. No commitment to any attendant proposed Participating Scientist Program (PSP), Data Analysis Program (DAP), or Guest Observer (GO) was made at Selection.

PSPs, DAPs, and GOs, where appropriate, will broaden the scientific impact of, and participation in, Discovery missions. These programs may be proposed as part of the CSR, but they will be separately reviewed at a later date by SMD and implemented, and funded, during the selected mission's Phase E. SMD will solicit and administer these programs using competitive peer review.

An additional page is allowed for discussion of each program.

Funding for PSP, DAP, and GO is considered outside the AO cost caps, and will result in a separate solicitation and decision by NASA, at a later date, as to whether to accept or reject these proposed expansions to the baseline science mission.

Deleted: This section is to also provide a cost estimate for performing any PSP, or DAP or GO. In completing this section, the guidelines for Phase C/D apply. ¶
¶
Complete a summary of costs according to the format shown in Figure 7. Include a discussion of the estimating techniques used to develop the cost estimates. These costs do not count against the NASA SMD cost cap.¶

L. APPENDICES

The following additional information is required to be supplied with the CSR. This information can be included as Appendices to the CSR, and, as such, will not be counted within the specified page limit.

1. Letters of Endorsement. Letters of endorsement must be provided from:
   - Any U.S. organization, including other Government agencies, or non-U.S. organization that is offering to contribute critical facilities (e.g., ground or space network(s), integration and test, thermal vacuum chambers, L-Tool, etc.), goods, hardware, software, and/or services.
   - Any U.S. organization, including other Government agencies, or non-U.S. organization that is offering to contribute the time and/or services of Co-Investigators, including E/PO participants. The letter must include the amount of the contribution in terms of approximate number of Full Time Equivalent (FTE) work years over the nominal duration of the proposed project (i.e., through Phase E) and the signature of an authorizing official of the individual's organization. In addition, the dollar value of the contribution must be included in the Total Mission Cost.
   - Any prime contractor, major subcontractor, or other participant that is named in the proposal and will provide critical hardware, facilities, goods, or services, whether contributed or not. The letter must include an acknowledgement of the work to be performed, a commitment to perform the work as proposed and for the cost proposed, and the signature of an authorizing official of the organization. The dollar value of the contract or subcontract that is expected to be funded through NASA if the proposal is selected must be included in the SMD Cost.
   - NASA or Government providers for services and/or facilities offered in the AO for which resources are limited. This includes the JPL Interplanetary Network Directorate (for the DSN), and others as applicable. The letter must include an acknowledgement of both the quantity and timing of resources required for the proposed effort, as well as the estimated cost of these resources and the signature of an authorizing official of the organization. The cost of the services and/or facilities must be included in the SMD Cost.
   - Letters from the original proposal may be reused if the scope of work has not changed.

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2. Subcontracting Plan. A preliminary subcontracting plan, outlining the proposed investigation's approach to small and small disadvantaged business subcontracting as described in Appendix A, Section XIII, of the AO, must be provided. This plan will be negotiated prior to any Phase B contract award.

3. Relevant Experience and Past Performance. Proposals must include a discussion of *relevant* experience and past performance by the major team partners in meeting the requirements of projects *similar* to the subject of the CSR. This can include airborne or space-based instrument development and investigations. For

this part of the CSR, NASA is seeking information *about the partner organizations* rather than individuals. Projects that ended more than 5 years ago need not be included in the discussion. The discussion of relevant experience and past performance must include a description of each project; its relevance to the subject of the CSR; the proposed performance and the actual performance; the planned delivery schedule of data to the PDS and the actual delivery schedule of data to the PDS, the proposed cost and actual cost; the proposed schedule and actual schedule; an explanation of any differences between proposed performance, cost and schedule and what was actually achieved; and points of contact for the past project's customer. If the customer for the past project was the United States government, then the contract number must be included along with current technical point(s) of contact and phone number(s). For projects that are not yet complete, the current projected performance, cost, and schedule must be used in place of actual values.

In evaluating the CSR, NASA will consider the past performance of the major partner organizations. The evaluation of past performance will not be arithmetic; instead, the information deemed to be most relevant and significant will receive the greatest consideration. Relevant experience will be viewed as the demonstrated accomplishment of work, which is comparable or related to the objectives of the CSR. This includes airborne or space-based instrument development and investigations and associated development processes including engineering processes, management processes, operations, data analysis and delivery of data to the PDS or other appropriate data archives. NASA will review the past performance information provided by the proposer. In addition, NASA may review, the major team partners past performance on other NASA and/or non-NASA projects or contracts that provide insight into those institutions past performance on airborne or space-based instrument development and investigations and associated development processes including engineering processes, management process, operations, data analysis and delivery of data to the PDS or other appropriate data archives. In conducting the evaluation, NASA reserves the right to use *all* information available.

The investigation team is cautioned that omissions or an inaccurate or inadequate response to the evaluation item will have a negative effect on the overall evaluation, and while NASA may consider data from other sources, the burden of providing relevant references that NASA can readily contact rests with the investigation team.

4. Resumes. Provide resumes for all key personnel identified in the Management section. Also provide resumes for key E/PO lead personnel. Include resume data on experience that relates to the job these personnel will be doing for the proposed investigation.

5. Statements of Work for each Contract Option. Provide draft Statement(s) of Work for all potential contracts with NASA. These Statement(s) of Work should (as a minimum) be for each contract option (i.e., Phase B, Phase C/D, and Phase E) and clearly define all proposed deliverables (including science data) for each

option, potential requirements for Government facilities and/or Government services, and a proposed schedule for each option and the entire mission.

6. Draft Requirements Appendix to Discovery Program Plan. Defines science requirements. An example is in the Discovery Program Library.

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7. Radioactive Heating Units (RHU) Plan (as applicable). Use of RHUs will require additional environmental review documentation consistent with NASA policy and procedures (14 CFR Part 1216, Subpart 1216.3), the National Environmental Policy Act of 1969, as amended (NEPA) (42 U.S.C. 4321 *et seq*.), and the Council on Environmental quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 CFR Parts 1500-1508). Missions that use RHUs will also be required to complete a separate administrative process for nuclear safety launch approval (Presidential Directive/National Security Council Memorandum No. 25). If RHUs are proposed for a selected and confirmed investigation, they will be provided by NASA as Government Furnished Equipment (GFE) through the Department of Energy, however, their costs must be included in a provided detailed plan and schedule that outlines the approach for implementing the above requirements.

8. Planetary Protection Approach. Investigation teams are encouraged to work with NASA's Planetary Protection Officer early in the Phase A concept study to verify/determine the appropriate planetary protection category and any special considerations and/or study requirements that may exist. This section should provide an approach to planetary protection consistent with *NPD 8020.7F, Biological Contamination Control for Outbound and Inbound Planetary Spacecraft*, and *NPR 8020.12B, Planetary Protection Provisions for Robotic Extraterrestrial Missions*, available through the DPL. Outline any special requirements on personnel, instrumentation, spacecraft assembly, facilities, launch configuration, and mission operations. For clarification of planetary protection requirements, contact the Planetary Protection Officer, Dr. Catherine Conley at (202) 358-3912, Cassie.Conley@nasa.gov

9. Incentive Plan(s). Draft Incentive Plans (if applicable) should be included with the concept study. Incentive Plans should outline contractual incentive features for all major team members. Incentive Plans should include both performance and cost incentives, as appropriate.

10. NASA PI Proposing Teams. The same guidelines as in Appendix B of the AO apply.

11. Technical Content of any International Agreement(s). Draft language for the technical content of any International Agreement(s) are required for all non-U.S. partners in the investigation. A sample agreement is available in the DPL Program Library. The draft language must include (i) a brief summary of the mission and the foreign partner's role in it, (ii) a list of NASA's responsibilities within the partnership, and (iii) a list of the non-U.S. partner's responsibilities in within the partnership. Note that NASA prefers to establish agreements with

government funding agencies, not with the institution which will be funded to perform the work.

12. Discussion on Compliance with U.S. Export Laws and Regulations. Provide an update to the discussion in the proposal. Investigations that include international participation, either through involvement of non-U.S. nationals and/or involvement of non-U.S. entities must include a section discussing compliance with U.S. export laws and regulations; e.g., 22 CFR 120-130, *et seq*. and 15 CFR 730-774, *et seq*., as applicable to the scenario surrounding the particular international participation. The discussion must describe in detail the proposed international participation and is to include, but not be limited to, whether or not the international participation may require the proposer to obtain the prior approval of the Department of State or the Department of Commerce via a technical assistance agreement or an export license, or whether a license exemption/exception may apply. If prior approvals via licenses are necessary, discuss whether the license has been applied for or, if not, the projected timing of the application and any implications for the schedule. Information regarding U.S. export regulations is available through Internet URLs http://www.pmdtc.org. Proposers are advised that under U.S. law and regulation, spacecraft and their specifically designed, modified or configured systems, components, parts, etc., such as the instrumentation being sought under this AO, are generally considered "Defense Articles" on the United States Munitions List and subject to the provisions of the International Traffic in Arms Regulations, 22 CFR 120-130, *et seq*.

13. Communications Link Budget Design Data. Include communications block diagram and link budget design control tables for all radio communications links (data and carrier) showing relevant spacecraft and earth station parameters and assumptions for the highest data rate and the emergency link at the maximum distance and throughput at which each particular link could be used. Particularly, provide losses, loop bandwidths, coding, antenna gains, and such other parameters identified in the document *NASA's Mission Operations and Communication Services,* in the DPL.

14. Full Mission Cost and Pricing for Phase B Contract. To assure that the deliverables via the CSR facilitate a direct and easily implementable Phase B contract, proposers must provide cost and pricing data for Phase B that meet the requirements of the FAR Part 15 Table 15-2 (see the DPL section on Directives and Procurement-related Information). This Phase B cost and pricing data is necessary and required to implement the contract. This data is in addition to the data provided in Cost figures 1-6 for evaluation purposes, allocates project costs per the cost categories defined in Table 15-2, but still aligns at the highest levels with the evaluation data. Also see Section J of Part II above for additional guidance.

Mission of Opportunity Cost and Pricing for Contract. To assure that the deliverables via the CSR facilitate a direct and easily implementable contract, proposers must provide cost and pricing data for all proposed

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phases that meet the requirements of the FAR Part 15 Table 15-2 (see the DPL section on Directives and Procurement-related Information). This cost and pricing data is necessary and required to implement the contract. This data is in addition to the data provided in Cost figures 1-6 for evaluation purposes, allocates project costs per the cost categories defined in Table 15-2, but still aligns at the highest levels with the evaluation data. Also see Section J of Part II above for additional guidance.

15. Additional Cost Data to Assist Validation. In addition to the specific cost table data requested in the Cost Proposal, Section J, proposers should also provide any additional costing information/data which they feel will assist NASA to validate the projects' proposed costs. Vendor quotes, cost estimates, rationale for design heritage cost savings, are all examples of data that can be included here. All costs to the lowest level of the proposers' WBS should be provided in an EXCEL or equivalent format.

16. Science Change Matrix. Should the Phase A effort result in any science change (including a science implementation change) from that originally proposed, provide the new requirement, the old requirement, the rationale for the change, and the section/paragraph where the change occurs in the CSR.

17. Data Management Plan Approach. Proposers must discuss all plans (schedules, costs, and deliverables) and their approach and commitment to delivering project data to the appropriate NASA data archives and indicate such in the plans and schedules for Phase B. In addition, this discussion must provide assurance that that all activities (womb to tomb) have been considered and included with appropriate resources separately allocated and budgeted. To ensure PDS compatibility, the Proposer's Archive Guide, available at <http://pds.nasa.gov/documents/>http://pds.nasa.gov/documents/, should be used as a guideline. Close coordination with a Project's designated Lead Node is necessary during development of the Data Management Plan to ensure that appropriate PDS formats and standards are adhered to. A Project Data Management Plan will be required at PDR.

18. Sample Curation Plan (if appropriate)
Discuss the plans for all aspects of curation of the samples. The Sample Curation Plan should describe the process and schedule for preparation of the curatorial facility, planned physical security, documentation, inventory process, environmental preservation measures, plans for distribution of the samples, preliminary examination of the samples, contamination control procedures, curation laboratory requirements, any modifications needed to the Astromaterials Curation Facility. Also, describe how a curatorial representative will work with the PI in planning the sample curation. Discuss all aspects of curation from planning through distribution and storage. Funding for use of the JSC Curatorial Facility, including all required laboratory construction or modification, must be included in the budget for the proposed mission. The actual costs for all aspects of curation from planning through distribution and storage will be borne by the mission from inception to two years following sample return.

See section 5.2.2 of the AO on Protocols and Policy for Handling Returned Samples and the "NASA Astromaterial Curatorial Facility" document in the Discovery Program Library for guidance on documentation, reviews and costs.

19. Orbital Debris Analysis. Discuss whether this is applicable to the proposal and if so discuss how the orbital debris requirements will be addressed. If applicable, detailed orbital debris analysis will be required for PDR and CDR, per NPD 8710.3, NASA Policy for Limiting Orbital Debris Generation. This document can be found in the NODIS and is linked from the DPL.

20. References List (Optional). The CSR may include, as an appendix, a list of reference documents and materials used in the concept study. The documents and materials themselves cannot be submitted, except as a part of the concept study.

21. Abbreviations/Acronyms List. To aid the evaluation effort, every abbreviation/acronym used in the CSR should be included in this table even if it has been defined at first usage in the Report.